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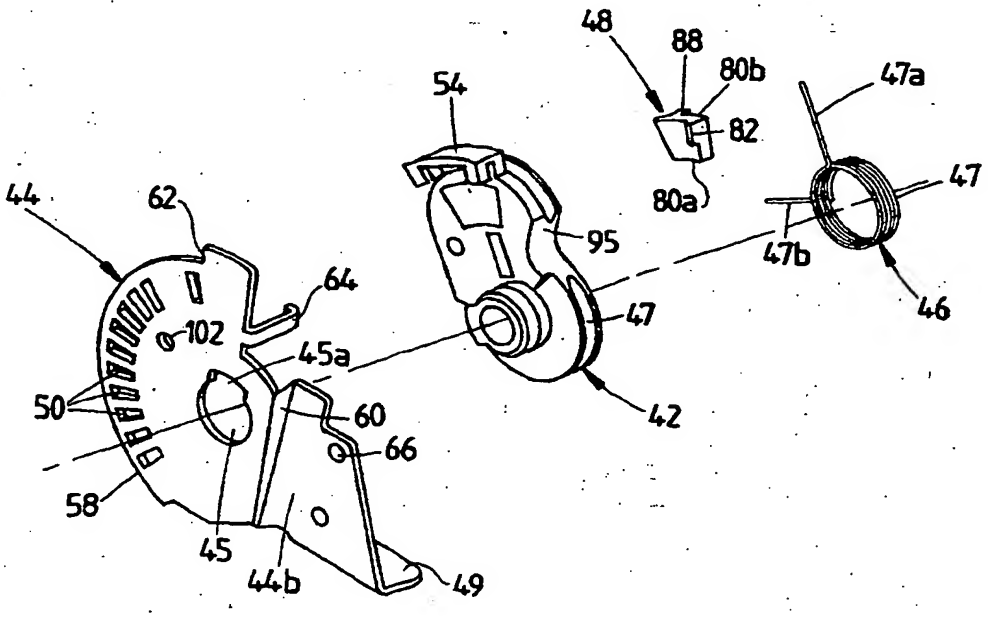

(57) Abstract

A line tensioning device (4) comprising a body (44), a line guide member (42) rotatably mounted to the body (44) and having means to seat and guide a line as it changes direction. The line tensioning device also comprises a spring (46) disposed to bias the line guide member (42) in one rotational direction whereby to tension the line and ratchet means (48, 50) coupling the line guide member (42) and the body (44). The ratchet means (48, 50) includes an engagement member (48) responsive to a very slow change in the operating rotational position of said line guide member (42) in one rotational direction, over multiple cyclic movements of the line, to move from one ratchet position to a next ratchet position.

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LINE TENSIONING DEVICE

This invention relates to the tensioning of lines such as looped operating cables and wires, and in one form is particularly suitable as a tensioner in bare cable window winder mechanisms in vehicles.

A known type of cable driven window winder mechanism for vehicles involves movement of a carrier, attached to the window glass, along a vertically aligned rail. The carrier is pulled up and down the rail by a pair of steel cables wound onto a drum. The drum is rotated either manually by a handle or electrically by a suitable motor. In so-called bare cable actuators, usually used where the rail and drum can be fixed relative to each other during manufacture, the respective cables are typically guided about pulleys at each end of the rail and are attached to opposite ends of the carrier. In sheathed cable actuators, typically employed where the rail and drum cannot be relatively fixed until after installation in the vehicle door, sheath clamps are employed instead of pulleys.

The most common arrangement to date for maintaining the necessary tension on the cables, including taking up slack which develops gradually with multiple cycles of operation, is a pair of spring-loaded sheath tensioning devices about the respective cables adjacent the drum. However, these devices do not prevent significant reversibility in the cables: the window can be forced slightly and may visibly rock up and down in rough driving conditions.

Two known alternative tensioning arrangements have endeavoured to replace the pair of sheath tensioning devices with a single mechanism. One involves separate drum segments for the respective cables, coupled by a rotary ratchet configuration. This arrangement features substantial irreversibility but is a relatively complex mechanism. Another proposal replaces one of the guide pulleys at the ends of the rail with an eccentrically rotatable, rotationally spring-loaded guide, but reversibility is still a problem with this arrangement.

It is therefore an object of the invention to provide an improved line tensioning device which, in at least one embodiment adapted to vehicle window winders, at least in part alleviates one or more of the disadvantages of prior arrangements.

The invention accordingly provides a line tensioning device comprising:

a body;

a line guide member rotatably mounted to the body, and having means to seat and guide a line as it changes direction;

a spring disposed to bias the line guide member in one rotational direction whereby to tension said line; and

ratchet means coupling said line guide member and said body, which ratchet means includes an engagement member responsive to a very slow change in the operating rotational position of said line guide member in said one rotational direction, over multiple cyclic movements of said line, to move from one ratchet position to a next ratchet position.

The body is preferably a plate member, there being means to securely maintain engagement between the plate member and the line guide member as the latter rotates.

The ratchet means preferably further includes plural recesses in the plate member defining successive ratchet positions of said ratchet means. These recesses are advantageously formed by cutting and bending or curving tabs in the plate member, which curved tabs thereby providing a minimal wear engagement with the tooth member as it rides out of a respective recess with said very slow change in the operating rotational position of the line guide member.

The tooth member is preferably a separate key element loosely retained in a cavity in the line guide member for engaging the aforesaid recesses in the plate member. Preferably, this tooth member/key element has a small slack in its fit in the cavity with respect to the rotation of the line guide member, so as to guard

against an excessive line tension under particular operating conditions.

The spring is preferably a coil spring, including a coil which is advantageously housed within the line guide member. Conveniently, a leg of the coil spring also retains the tooth member key element in its cavity.

In an advantageous application, the line tensioning device of the invention is incorporated in a cable-driven vehicle window winder mechanism, for tensioning the cable of the mechanism.

The invention will now be further described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is an exploded all-line diagrammatic view of the principal components of a bare cable vehicle window winder mechanism incorporating an embodiment of line tensioning device according to the invention;

Figure 1A is an enlargement of the components of the line tensioning device in Figure 1;

Figure 2 is a front elevation of the base plate forming part of the line tensioning device shown in Figure 1;

Figures 3 and 4 are respectively an edge perspective view and a side elevation of the base plate;

Figures 5 and 6 are rear and side elevations of the cable guide cam of the line tensioning device shown in Figure 1;

Figures 7 and 8 are respective cross-sections on the lines 7-7 and 8-8 in Figure 5;

Figures 9 and 10 are respective top and rear elevational views of the key element providing the tooth component of the ratchet means of the line tensioning device; and

Figure 11 is a diagram illustrating the slack in the fit of the key element in its cavity in the cable guide cam, and the manner in which the guide acts as a cam with respect to the key element.

The window winder mechanism 10 illustrated in Figure 1 includes a generally vertically extending rail 12, a carrier 14 with a slider 15 by which the carrier is slidable along the rail, and a drum 16 onto which respective upper and lower cables 18,19 are wound. Cables 18,19 pass respectively around an upper pulley guide 22 and a lower cable guide cam 42 (the reason it is referred to as a cam will become apparent later), and are fixed to the top and bottom of carrier 14. Drum 16 is keyed for rotation on a shaft 20: rotation of the shaft by a handle or an electric motor (not shown) in respective directions is effective to wind up one cable and unwind the other and thereby move carrier up or down rail 12.

Rail 12 is slightly bowed to match the typical curve of a vehicle door, and is secured in place by upper and lower mounting brackets 24,25. Carrier 14 is attached to a vertically slidable door window (not shown). Shaft 20 also carries a clutch cap 26 and clutch spring 28, the assembly of shaft, drum, clutch cap and clutch spring being carried between a support bracket 30 and drum cover 32. This arrangement is generally conventional and does not form part of the invention per se.

Upper pulley guide 22 is carried by a stub shaft 33 which is fixed to a bracket 34. Cable guide cam 42 is one element of a line tensioning device generally indicated at 40 and forming an embodiment of the invention. Device 40 serves to tension cables 18,19 on assembly of the whole window winder mechanism, to maintain tension, and to compensate for slack which gradually develops in the mechanism after many cycles of operation.

The components of tensioning device 40 include a body provided by a base plate 44, a line guide member in the guise of cable guide cam 42, a coil spring 46, and ratchet means comprising an engagement member in the form of a key element 48 and an arc of recesses 50 in base plate 44.

Cable guide cam 42 is moulded in a plastics material such as polyacetal and has an annular hollow boss 43 by which it is rotatably mounted in an aperture 45 in base plate 44. Guide cam 42 further has a peripheral V-groove 47 to seat and guide lower cable 19. Guide cam 42 is somewhat longer than it is wide, having respective similarly radiussed semi-circular ends 52,53, one of which (52) is concentric with boss 43, and the other of which (53) carries an integral outstanding arcuate projection 54. Projection 54 is on the same side of guide cam 42 as boss 43 and has undercut groove 55 which receives and is thereby guided by a matching concentric edge 58 of base plate 44. Edge 58 and groove 55 are also concentric with both the locus of ratchet recesses 50 and aperture 45. The rotatable mounting of the guide cam on the base plate is further secured by a key lug 43a on boss 43; this lug registers with a notch 45a in aperture 45 when the guide cam is oriented downwardly, from which position rotation of the guide cam 42 will bring projection 54 into engagement with the lower end of base plate edge 58.

Base plate 44 is pressed from a suitable metal and has two planar segments 44a,44b offset by 7° (Figure 4) and joined by a twist web 60. Segment 44a includes curved edge 58 opposite web 60, ratchet recesses 50, and aperture 45/notch 45a for receiving the boss 43 of guide cam 42. Ratchet recesses 50 are generally rectangular and are formed by cutting and curving integral tabs 51 (Figure 11) in base plate 44 and angularly bending or curving the tips 73 of these tabs. Segment 44a also defines a stop 62 at the upper end of edge 58 (to limit travel of projection 43 and therefore of the guide cam), and an arm 64 projecting rearwardly from the plane of the plate to provide an abutment for a leg of coil spring 46. On assembly of the mechanism, base plate segment 44b is projection welded at holes 66 to the lower end of rail 12. A bottom flange 49 on plate segment 44b provides a bottom limit stop for the carrier 14, which is fitted with a bump stop 49a to strike flange 49. The offsetting of

segment 44a relative to fixing segment 44b correctly aligns the V-groove 47 of guide cam 42 with the line of travel of cable 19 from drum 16.

The key element 48 of the ratchet means seats in an opening 70 through cam guide 42 between boss 43 and curved end 53. Opening 70 has arcuate inner and outer faces 71a,71b concentric with boss 53/aperture 45, radial side faces 72a,72b, and a square undercut 74 (Figure 8) at the front edge of side face 72a (i.e. adjacent base plate 44). Key element 48 (Figures 9 to 11) is of matching configuration, comprising a moulding of a suitably hard plastics material such as polyacetal. It has a main body extending between curved inner and outer faces 80a,80b, and flat side faces 81a,81b. Its thickness matches square undercut 74 and its arcuate length is a little less ℓ, e.g. 2mm (Fig. 11A), than the separation of side face 72b of opening 70 and the remote curved end face of undercut 74. On the side facing base plate 44, the key element is shaped to form a half-width tapered ratchet tooth 82 for engaging recesses 50. This tooth has a normal leading face 83 contiguous with side face 81b and a gently tapered trailing face 84. Trailing face 84 matches the angled tips 73 of tabs 51 defining recesses 50 in base plate 44.

Adjacent its side face 80a, the key element is tapered as at 86. At the rear of this taper 86, an integral square-section rib 88 is formed on the main face opposite tooth 82. The tapered portion 86 is dimensioned to fit neatly into square undercut 74 (Figure 11).

Key element 48 is retained in opening 70 by a leg of coil spring 46. The spring coil 47 is housed in an annular cavity 55 about a rearward extension 51 of boss 43 of guide cam 42, and retained when wound up by tangs 90 at the end of the extension. One leg, 47a, of the spring lies across opening 70, between rib 88 of the key element 48 and the side faces of opening 70, passing along a groove 91 under an overlying retention lug 92 formed integrally with the guide cam. The other leg 47b sits outwardly and, once the spring is wound, abuts arm 64 of base plate 42.

The initial assembly of the tensioning mechanism will now be described.

Referring to Figure 1, the guide cam boss 43 is engaged with aperture 45 with the guide cam extending downwards from the boss and lug 43a aligned with notch 45a. The guide cam is then rotated to engage and follow edge 58 until the end of projection 54 strikes stop 62. Side cutout 95 in the guide cam accommodates arm 64 at this position. At this point a temporary pin (not shown) is passed through registered holes 102,103 in the base plate and guide cam, to fix the relative positions of the two. Key element 48 is dropped into opening 70, its ratchet tooth 82 being received into the uppermost 50a of recesses 50, which, as will be observed, is set apart a little from the other ratchet recesses. Coil spring 46 is now dropped onto boss extension 53a, with its leg 47a in groove 91 under lug 92, and wound up. On being wound, the coil reduces in diameter and is thereby held in place behind tangs 90, with leg 47b biased behind arm 64, and leg 47a biased against key element rib 88.

The device, with the pin still in place in holes 102,103, is now ready to be included in the whole winder mechanism and is therefore fastened to rail 12. When the winder mechanism is complete, and the cables 18,19 are in position attached to the drum and carrier, and led around the pulley guide 22 and guide cam 42, the pin is removed from holes 102,103. Immediately, coil spring 46 acts (via its leg 47a and key element rib 88 against side face 71b of opening 70) to rotate guide cam 42, thereby laterally displacing and tensioning cable 19, until the cable tension balances the spring force: this is the initial setting. During this rotation, key element tooth 82 typically ratchets in and out of successive recesses 50.

In use, when the window is being wound up, any cable slack will occur at the bottom and will be taken up by further slight rotation of guide cam 42. When the window is wound down, the pull is in the lower cable 19 and the guide can drop back until tooth 82 drops into a recess 50 and locks the guide cam against further movement. This ratchet action also prevents slackening of the cable due to reverse window movement, and thus guards against forced partial lowering of the window or oscillation of the window in rough conditions.

The slightly loose mounting of key element 48 in opening 70, provided by the earlier noted 2 mm difference ℓ (Figure 11A) between the arcuate lengths of the key element and the opening, prevents excessive and possibly destructive winding force arising in the cable mechanism by ensuring that there is always a slight slack when changing from winding up to winding down, even when the balance key element position for winding up is at a ratchet lock position. This slack is illustrated in the diagrams in Figures 11A and 11B.

As the winder mechanism is subjected to successive cycles of operation over a period of time, wear at various locations, as well as cable stretch, introduces a gradually increasing degree of slack into the cables. The illustrated device compensates for this during winding up by gradually increasing the distance that the key element is cammed back by guide cam 42, from the current ratchet position for winding down, until the key element clicks into the next ratchet recess. During the successive camming actions during winding up, the key element rides out of the present recess 50 along the surface of the base plate, as depicted in Figure 11B. The taper 86 allows this loose rotating movement of the key element to occur, and the gently angled and sloped surface defined by the bent tips 73 of tabs 51 (in contrast to a sharp edge if the recesses were punched out) minimises wear on the rearward face 84 of the tooth 82.

It will be appreciated that the illustrated tensioning device is of simple construction and easy assembly. It provides initial cable tensioning during assembly as well as an in-built adjustment to compensate for gradual cable slack arising with long term use. The tensioning device is a single unit which also prevents window wobble and reverse forcing, yet has an in-built small degree of slack to guard against excessive winding force.

Throughout this specification and the claims which follows, unless the context requires otherwise, the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

CLAIMS:-

1. A line tensioning device comprising:

a body;

a line guide member rotatably mounted to the body, and having means to seat and guide a line as it changes direction;

a spring disposed to bias the line guide member in one rotational direction whereby to tension said line; and

ratchet means coupling said line guide member and said body, which ratchet means includes an engagement member responsive to a very slow change in the operating rotational position of said line guide member in said one rotational direction, over multiple cyclic movements of said line, to move from one ratchet position to a next ratchet position.

2. A line tensioning device according to claim 1, wherein said body is a plate member, means being provided to securely maintain engagement between the plate member and the line guide member as the latter rotates.

3. A line tensioning device according to claim 2, wherein said ratchet means further includes plural recesses in the plate member defining successive ratchet positions of said ratchet means.

4. A line tensioning device according to claim 1, wherein said recesses are formed by cutting and bending or curving tabs in the plate member, which tabs thereby providing a minimal wear engagement with the tooth member as it rides out of a respective recess with said very slow change in the operating rotational position of the line guide member.

5. A line tensioning device according to claim 3 or 4, wherein said engagement member is a separate key element loosely retained in a cavity in the line guide member for engaging the aforesaid recesses in the plate member.

6. A line tensioning device according to claim 5, wherein said key element has a small slack in its fit in the cavity with respect to the rotation of the line guide member, so as to guard against an excessive line tension under particular operating conditions.

7. A line tensioning device according to any preceding claim, wherein said spring is a coil spring, including a coil which is housed within the line guide member.

8. A line tensioning device according to claims 5 and 7, wherein a leg of said coil spring also retains the key element in its cavity.

9. A line tensioning device substantially as hereinbefore described with reference to the accompanying drawings.

10. A cable-driven vehicle window winder mechanism incorporating a line tensioning device according to any preceding claim, mounted to engage and tension a drive cable of the mechanism.

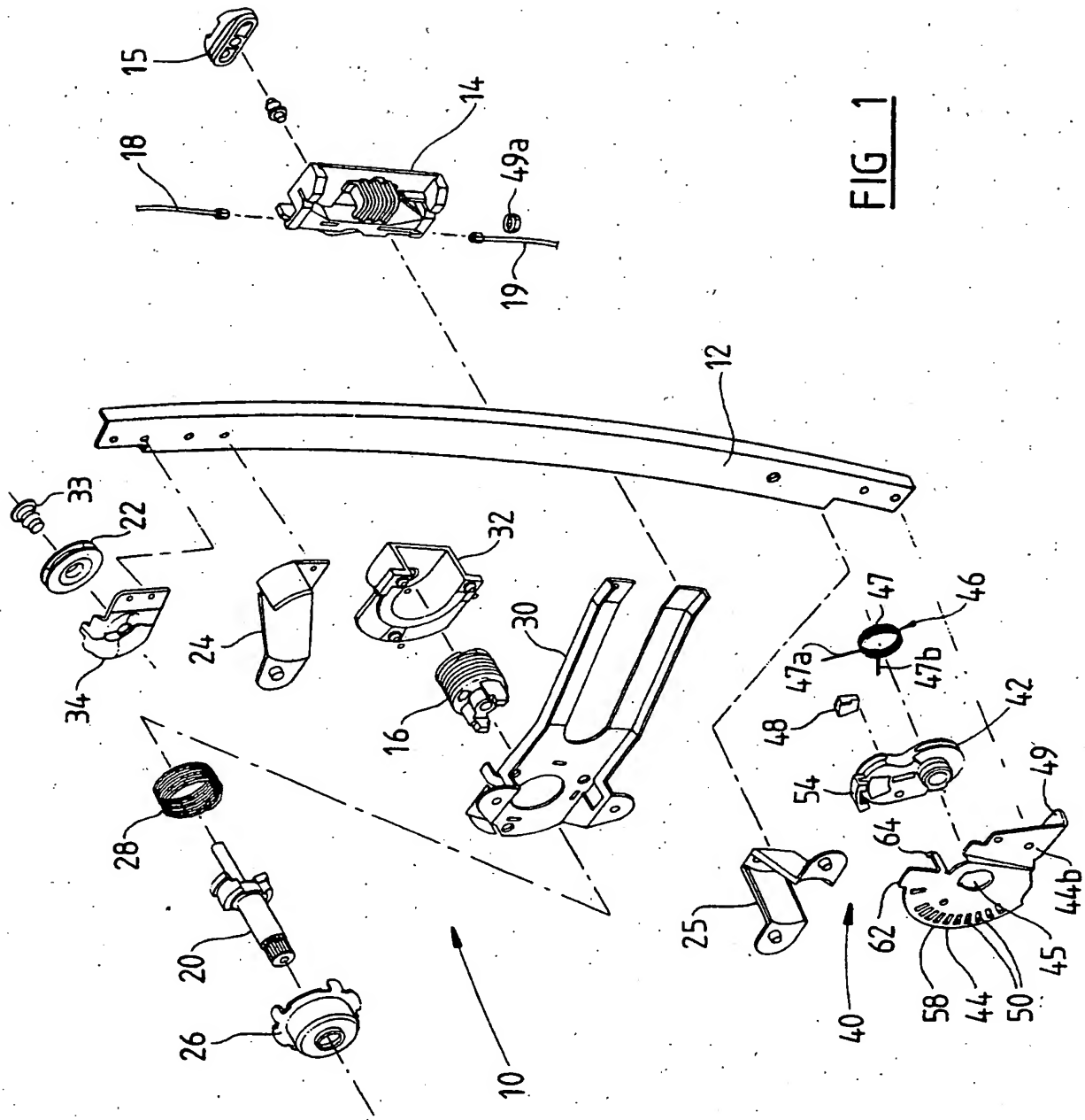
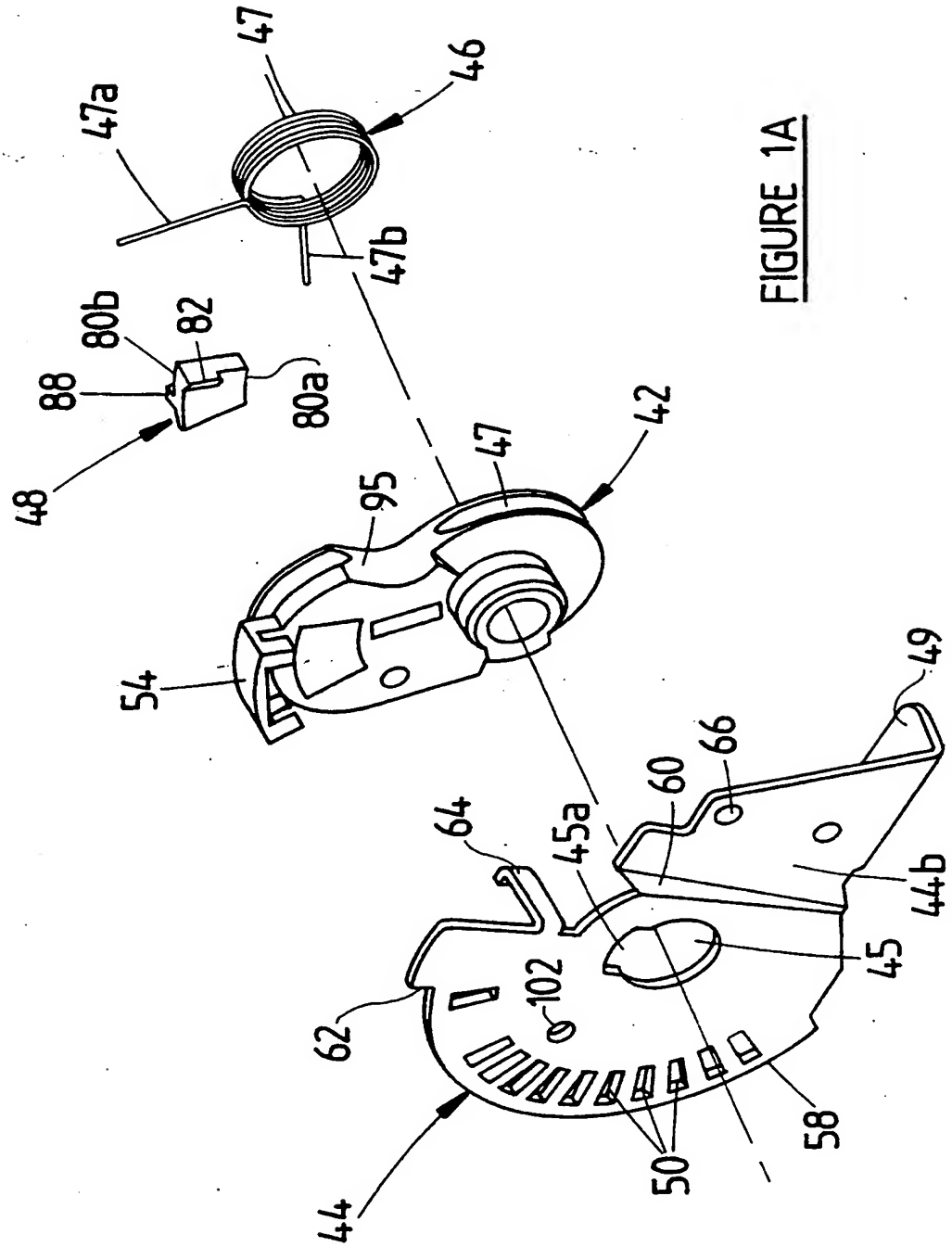


FIG 1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102
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50
44

FIGURE 1A

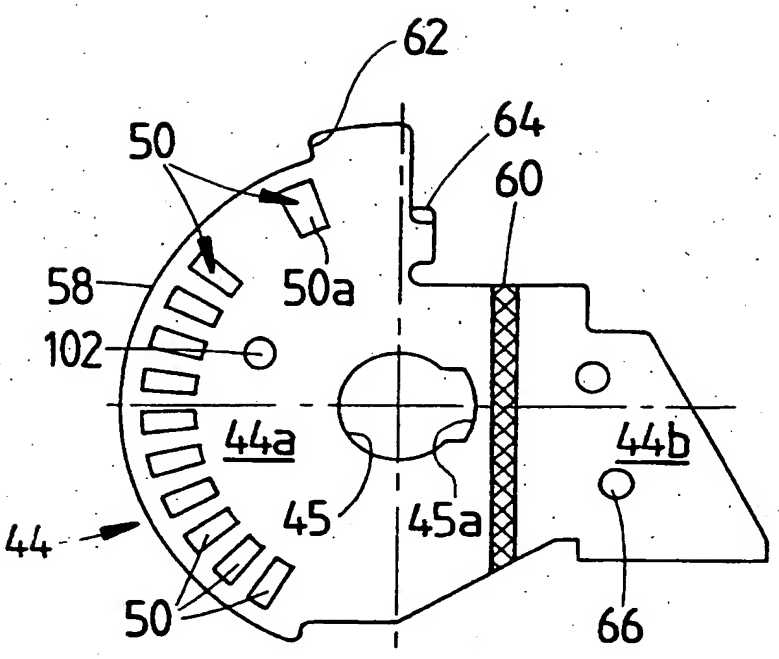

FIGURE 2

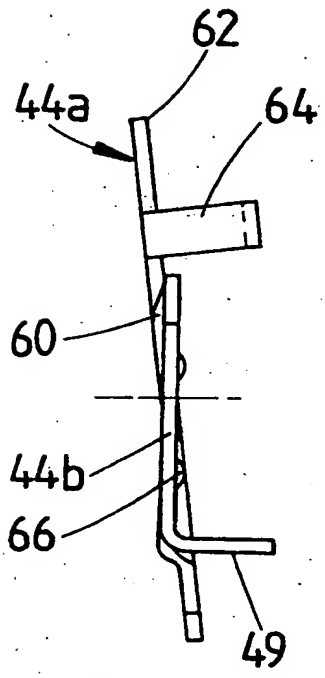

FIGURE 4

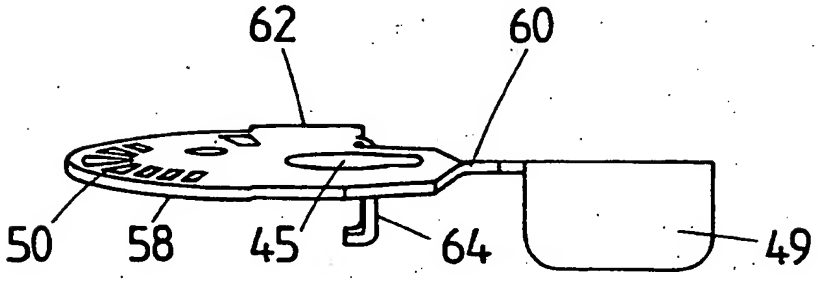

FIGURE 3

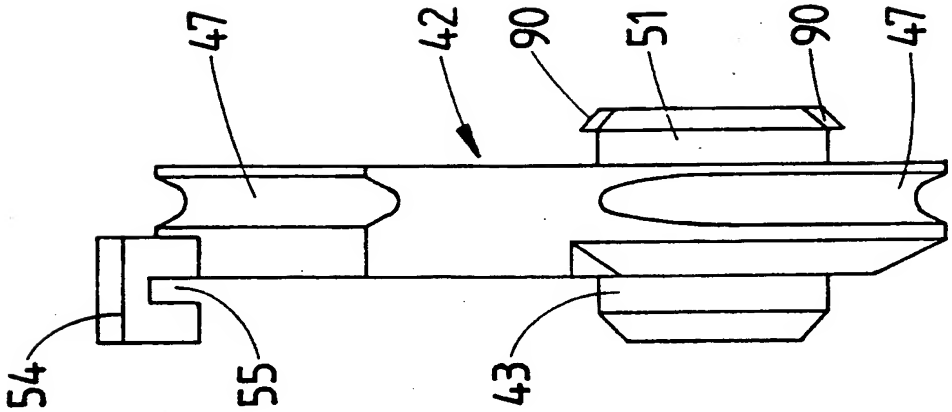

FIGURE 6

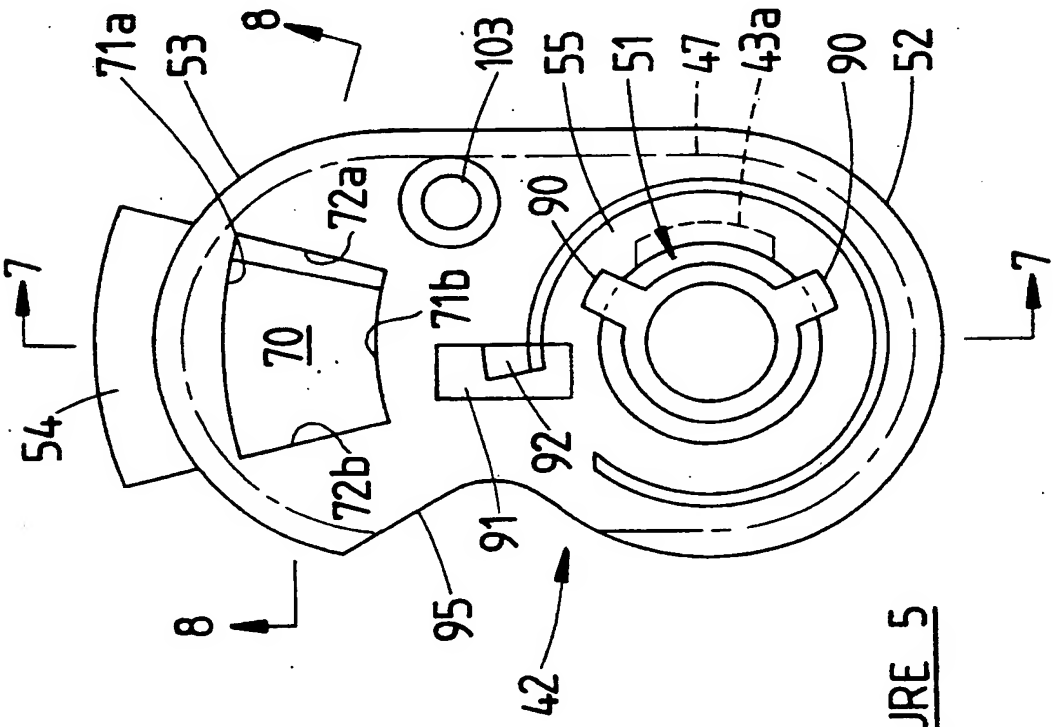

FIGURE 5

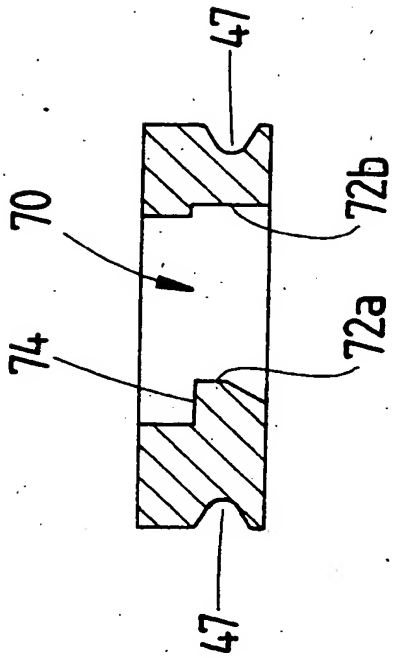

FIGURE 8

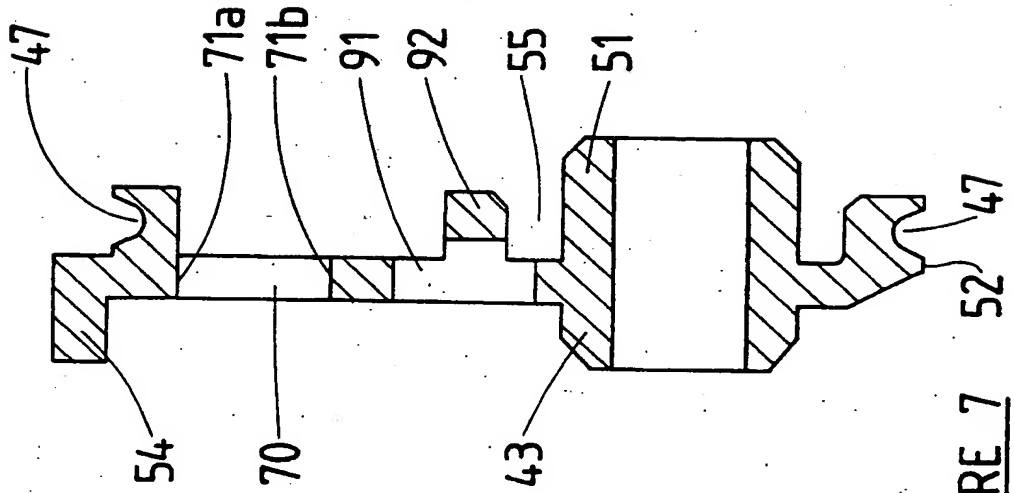

FIGURE 7

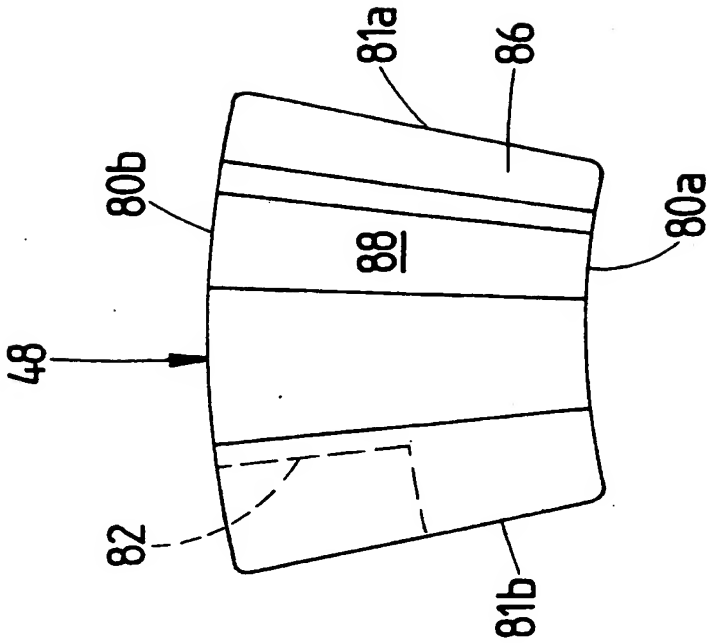

FIGURE 10

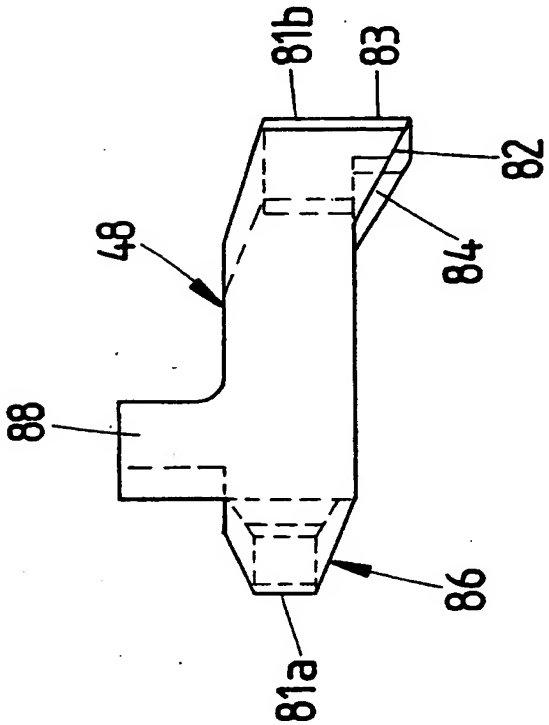

FIGURE 9

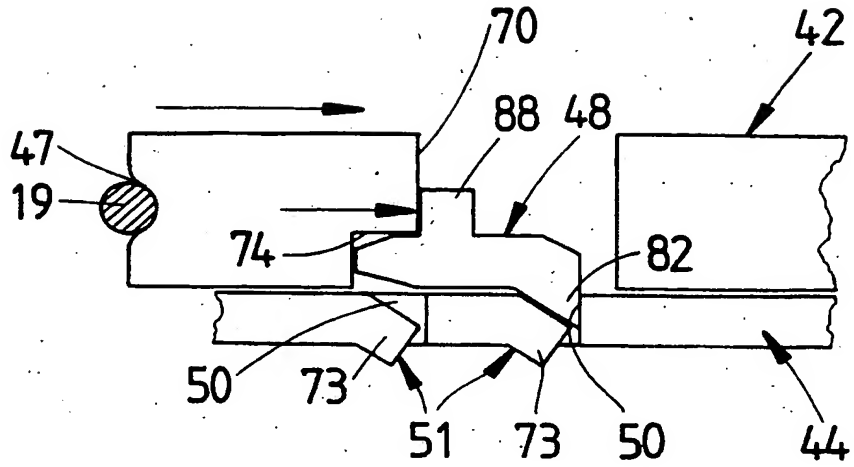

FIGURE 11A

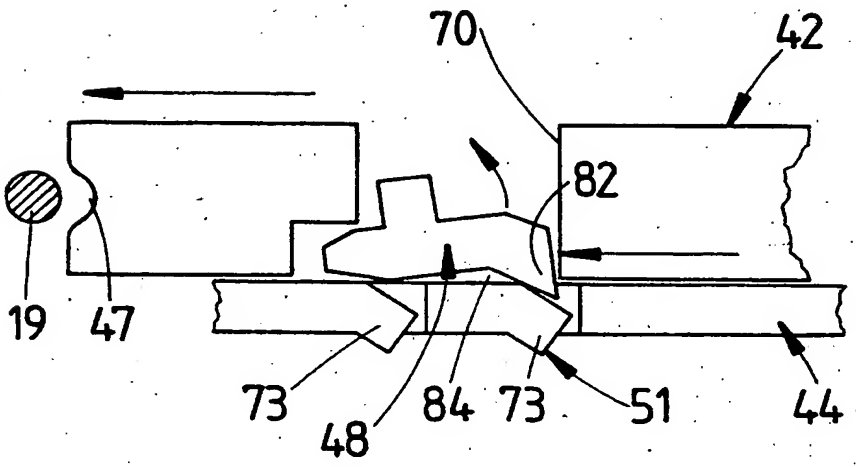

FIGURE 11B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 94/00340

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.[5] E05F 11/48

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC : E05F 11/48

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	DE,A, 350793 (PERFECT WINDOW REGULATOR CO) 27 March 1922 (27.03.22)	1-8,10
A	GB,A, 213819 (FRANKS) 10 April 1924 (10.04.24)	1-8,10
A	Patent Abstracts of Japan, M 1161, page 81, JP,A, 3-151482 (NIPPON CABLE SYST INC) 27 June 1991 (27.06.91) Abstract	1-8,10
A	Patent Abstracts of Japan, M 664, page 110, JP,A, 62-188812 (NHK SPRING CO LTD) 18 August 1987 (18.08.87) Abstract	1-8,10

[X] Further documents are listed in the continuation of Box C.

[ ] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
29 August 1994 (29.08.94)	8 Sept 1994 (08.09.94)

Name and mailing address of the ISA/AU

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate of the relevant passages	Relevant to Claim No.
A	Patent Abstracts of Japan, M 697, page 65, JP,A, 62-278354 (KOITO MFG CO LTD) 3 December 1987 (03.12.87) Abstract	1-8,10
A	Patent Abstracts of Japan, M 883, page 57, JP,A, 1-182616 (NIPPON CABLE SYST INC) 20 July 1989 (20.07.89) Abstract	1-8,10
A	Derwent Abstract Accession No. 87-250976/36, Class Q12 Q47, DE,A, 3615578 (AUDI AG) 10 September 1987 (10.09.87) Abstract	1-8,10